What are Genetically Engineered (GE) Crops?

Genetic Engineering is the introduction of a specific gene into the DNA of a plant to obtain a desired trait. The gene introduced may come not only from another plant species, but also from other organisms. While traditional plant breeding involves crossing related plants, biotechnology is a new tool that enhances the capability of breeders to be more precise.

WHAT ARE THE GOALS OF GENETIC ENGINEERING?

The goals of genetic engineering are the same as with traditional breeding. They may aim to improve crop performance in the field by conferring pest and disease resistance, herbicide resistance, or tolerance to environmental stresses (such as drought or flooding). They may also aim to develop products with enhanced value, such as improved post-harvest life, nutritional value, or other health benefits.

Insect resistance

In the last few years, several crops have been genetically engineered to produce their own Bt proteins, making them resistant to specific groups of insects. "*Bt*" is short for *Bacillus thuringiensis*, a soil bacterium that contains a protein that is toxic to a narrow range of insects, but not harmful to animals or humans. Applications of *Bt* bacteria have been used to control insect pests for many years, before the advent of the current *Bt* crops made using biotechnology.

Varieties of Bt insect-resistant corn and cotton are now in commercial production. Other crops being investigated include cowpeas, sunflower, soybeans, tomatoes, tobacco, walnut, sugar cane, and rice.

Bt Corn field at the University of the Philippines, Los Baños

Herbicide tolerance

Chemical herbicides are frequently used to control weeds. Weeds growing in the same field with crop plants can significantly reduce crop yields because the weeds compete for soil nutrients, water, and sunlight. Many farmers now control weeds by spraying herbicides directly onto the crop plants. Because these herbicides generally kill only a narrow spectrum of plants (if they didn't, they would kill the crop plants, too), farmers apply mixtures of multiple herbicides to control weeds after the crop has started to grow.

Researchers realized that if a crop plant is genetically engineered to be resistant to a broad-spectrum herbicide, weed management could be simplified and safer chemicals could be used. It is often argued that such GE varieties reduce soil erosion, because they make adoption of soil-conserving practices such as "no-till" easier. Resistance to synthetic herbicides has been genetically engineered into corn, soybeans, cotton, canola, sugar beets, rice, and flax. Some of these varieties are commercialized in several countries. Research is ongoing on many other crops. One application of this technology is that herbicide could be coated on seed from an herbicide resistant variety (for example, maize) and while the maize would germinate and thrive, weeds and parasites such as *Striga* would be killed.

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Virus resistance

Many plants are susceptible to diseases caused by viruses, which are often spread by insects (such as aphids) from plant to plant across a field. The spread of viral diseases can be very difficult to control and crop damage can be severe. Insecticides are sometimes applied to control populations of transmitting insects, but often have little impact on the spread of the disease. Often the most effective methods against viral diseases are cultural controls (such as removing diseased plants) or plant varieties bred to be resistant (or tolerant) to the virus, but such strategies may not always be practical or available. Scientists have discovered new genetic engineering methods that provide resistance to viral disease where options were limited before.

- In the US, several varieties of squash and zucchini resistant to three important viral diseases have been developed and commercialized.
- Beginning in 1992, a devastating outbreak of Papaya Ring Spot Virus (PRSV) swept through the papaya plantations of Hawaii—papaya production dropped 40% in the course of 5 years. Researchers in Hawaii and at Cornell University developed two GE varieties of papaya resistant to PRSV. Papaya growers in Hawaii have been able to grow GE virus resistant papaya since 1998.
- Scientists are currently developing virus-resistant crops for Africa, including cassava, maize and sweet potato.

Delayed fruit ripening

Delaying the ripening process in fruit is of interest to producers because it allows more time for shipment of fruit from the farmer's fields to the grocer's shelf, and increases the shelf life of the fruit for consumers. Fruit that is genetically engineered to delay ripening can be left to mature on the plant longer, will have longer shelf-life in shipping, and may last longer for consumers.

Foods with improved nutritional value

Researchers are using biotechnology for the development of foods with improved nutritional value. Genetic modification can be used to produce crops that contain higher amounts of vitamins to improve their nutritional quality. Genetically altered "golden rice," for example, contains three transplanted genes that allow plants to produce beta-carotene, a compound that is converted to vitamin A within the human body. Vitamin A deficiency—the world's leading cause of blindness—affects as many as 250 million children. Biotechnology has also been used to alter the content of many oil crops, either to increase the amount of oil or to alter the types of oils they produce. Biotechnology could also be used to upgrade some plant proteins now considered incomplete or of low biological value because they lack one or more of the 'essential' amino acids. Examples include maize with improved protein balance and sweet potatoes with increased total protein content. Reducing toxicity of certain foods is also a goal of biotechnology. For example, reduction of the toxic cyanogens in cassava has been shown to be possible and could be produced in the future.

Sources:

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